PRACTICAL NOTES

ON

HOUSE SANITATION.

By DAVID W. BUCHAN,

Qualified Registered Plumber,

Sanitary and Ventilating Engineer,

First-class Honoursman and Medallist in the Principles of Plumbers' Work, and in the Practice of Plumbing, City and Guilds of London Institute, 1889-90,

etc., etc.

GLASGOW:

MACLAREN & SONS, PUBLISHERS AND PRINTERS,

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With Compts

W. P. Buchan

Dedicated

To the Memory of the Late

WM. P. BUCHAN,

Sanitary and Ventilating Engineer,
Glasgow.

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The intention of the following pages is not to instruct my fellow-tradesmen, but rather to give a few hints on Sanitary matters as pertaining to the house, which may prove useful for the guidance of the householder or house-hunter.

NOTE.—The diagrams are from Buchan's books on "Plumbing" and "Ventilation," by the kind permission of the publishers, Messrs. Crosby Lockwood & Son, London.

36 Renfrew Street,
Glasgow, *January*, 1898.

PRACTICAL NOTES

ON

HOUSE SANITATION.

THE OLD HOUSE.

OUR perambulations through old houses reveal the fact that little attention was paid to sanitary matters in days gone by. Defects are found everywhere, from the cellars to the house tops. The drains leak, the piping in connection therewith is defective, and the water used for dietetic purposes is generally found more or less contaminated by foul air. No wonder then that the cause of many an illness has been traced to the imperfect sanitary condition of the house.

It seems to have formerly been the plan to have the W.C. apartments as near the bedrooms as possible, and in many cases in the centre of the house, and with little or no provision for sufficient light and ventilation.

No attempt at isolation of the different fittings was thought of, the W.C. soil-pipe generally acting as the conduit for baths, basins, sinks, and roof water. This plan, no doubt, was bad, as the termination of the foul piping at the eaves of roofs near windows, and under overhanging slates at gutters, directed the foul air into the house again, greatly assisted by the draught of the fires when burning. With the advance of time "science" has found out the death-traps which lay hidden in our abodes, and the Medical Faculty have proved that sewer and sewage air is a dangerous companion with which to live.

The question now arises—What should be done to render the older class of houses more healthy for habitation? It can scarcely be expected that a proprietor should carry out the whims of the sanitary engineer in every detail, so as to transform an old house into a new one thoroughly up-to-date in all that modern sanitation

demands. Such an expenditure would be asking too much of a proprietor. Still, a tenant has a right to have his house free from the entrance of sewer or sewage air, no matter at what cost.

Much, however, can generally be done to remedy the defects of leaking drains and pipes; but the older patterns of many fittings, and their modes of connection, are a source of danger in themselves, and in order to have a healthy house the following are the most important points in the sanitary arrangements to which special attention should be directed:

1. The fittings should be so constructed that no concealed parts exist where filth can lodge.

2. They must be so arranged that all waste matters can be conveniently and speedily removed by a forcible scour of water.

3. All fittings should be properly trapped and ventilated to guard against siphonage of their water traps.

4. The drains and piping in connection therewith must be sound, and proof against the entrance of sewage gas into the house, and be open to the air at both ends.

5. The drainage system must be intercepted from the sewer by a proper intercepting trap.

6. A circulation of air must be maintained through all the foul waste piping.

7. The foul exit pipes ought to be carried clear of all windows, etc.

8. Water for dietetic purposes should be drawn, if possible, direct from the main, and in no case from a W.C. cistern.

9. Water for storage, drinking, and dietetic purposes should have independent cisterns of proper material, covered over, and placed to admit of easy inspection.

10. Cistern overflows should not in any way be connected to foul waste piping, but should deliver into the open air or into other suitable place, according to circumstances.

Such are a few of the more important points, attention to which will tend to make an old house healthy for habitation. Many more could be enumerated, but perhaps a brief description of Sanitary Engineering, as applied to a modern house, will more fully show how to have our homes healthy from a sanitary point of view.

THE NEW HOUSE.

For simplicity and clearness let us take a villa and follow out its construction until it is finally ready for the occupants.

A house having a southerly outlook is generally to be preferred in this country, at all events for the living rooms.

The site having been chosen, the character of the soil at once demands attention, first as to its possible dampness, and second with regard to the nature of the ground air with which it may be permeated. The best site is on ground from which the subsoil water tends naturally to drain, but as it is not always possible to have any great choice as to site, the soil may be made comparatively dry by subsoil drainage. A damp foundation will render the house wet and cold, and tend naturally to render the house unhealthy.

Atmospheric changes again tend to render the soil damp, and the breathing of such air and its impurities is no doubt injurious to the inmates of the house. The fires, by causing draughts, are responsible for drawing the soil air into the house.

A damp-proof course in the walls is now recognised as a preventive for damp walls, and the covering of the soil under the basement flats of the house with impervious material such as asphalt, tends to make our homes more healthy, dry, and free from polluted soil air.

Air gratings in the wall for the ventilation of the basement space under the flooring are necessary as a preventive against dry rot.

The builder having so far looked to the foundations, in course of time, as the building proceeds, provision for the ventilation of the various apartments will demand attention. We know the ordinary fireplaces help materially to carry away a certain amount of vitiated air, but owing to their lowness are of little use for removing the vitiated air from gas combustion, etc., which, owing to its higher temperature, naturally rises to the ceiling.

If an opening into the vent under the cornice is made, and a

mica flap chimney ventilator as shown at Fig. 1 fixed therein, the vitiated air will find a ready exit. These chimney ventilators will act best (1) when the area of the contracted chimney throat at the fireplace and that of the ventilator do not exceed the outlet area at the top; and (2) when there is a sufficient supply of fresh air coming into the room.

The introduction of these chimney ventilators will not entail any alteration on existing fireplaces provided they have good-going vents; but the ventilators are better to have hit and miss fronts, for regulating purposes, if required.

Another method, much to be preferred, of providing for the outlet ventilation of the various apartments is that shown in Fig. 2, where special air shafts H are built alongside of the chimney flues.

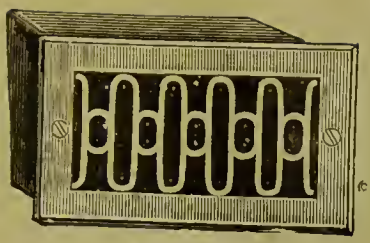
These air shafts may be either rectangular or round, may be built of brick, or, better still, they may be stoneware or iron pipes which are smooth inside and allow of less friction than when built of brick. Their sizes will vary say from 9 inches by 6 inches upwards. A mode of calculating for the outlet ventilation of bedrooms is to allow 10 square inches of outlet area for the room, and then from 2 to 4 square inches more for each occupant. For the prevention of down draughts or suck-down in these air shafts, vertical silk flap ventilators similar to Fig. 1 are fixed in the room under the cornice at H (Fig. 2).

A good way of terminating is that shown at R (Fig. 2) below the chimney cornice, where two gratings, one on either side of the vent, form a through and through outlet. Larger rooms are always better ventilated by having several smaller outlets than one large one.

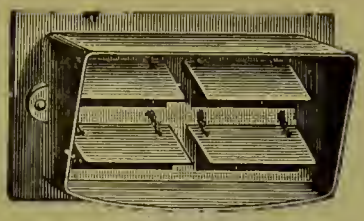
So much for the outlet ventilation, but no air will go out unless a supply of air is brought in to supply the necessary motive power. The entrance of air is, however, by no means limited, as air is drawn from every crevice around the windows, doors, skirting, etc., and the health of the occupants of many houses depends on these inlets alone. A common cause of smoky chimneys is the insufficiency in the amount of air supplied to the apartment.

Air, as it is exhaled from the lungs, has a temperature of about 70 degs., so, on account of its warmth, it naturally rises, and if assisted by incoming fresh air at a lower level, may be carried off before it cools and falls again if an outlet is provided. Again, exhaled air contains about a hundred times as much carbonic acid as fresh air, which contains 4 volumes in 10,000, so that ventilation,

Fig. 1.



FRONT VIEW.



BACK VIEW.

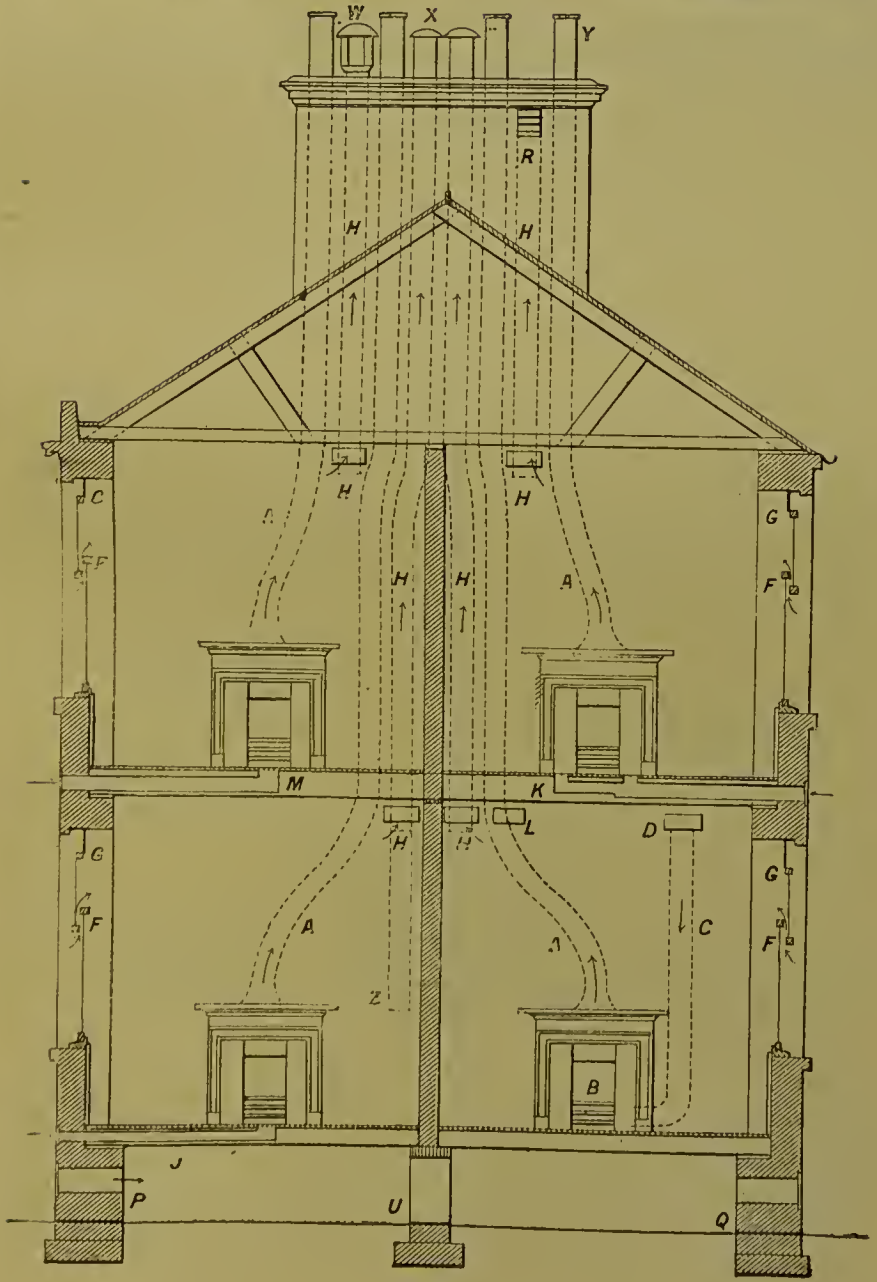


Fig. 2.

which means carrying away the foul air while supplying fresh air, is necessary to good health. In good ventilation the change of air should take place without being perceptible; but the manner in which fresh air is introduced into an apartment is often the cause of cold draughts.

Authorities inform us that 2000 (some say 3000) cubic feet of air per hour are required if a person is to be kept in good health. As the

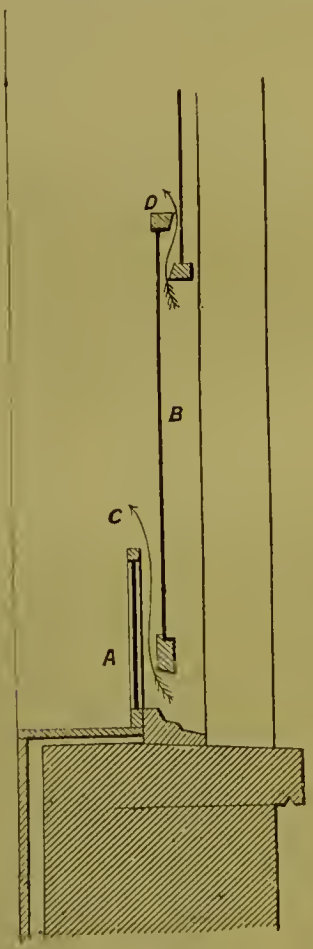


Fig. 3.

cubic capacity of many bedrooms is even less, how can 16,000 cubic feet of fresh air be supplied for an eight hours occupancy if there is no provision for ventilation?

On entering a badly ventilated bedroom after occupancy the sense of smell reveals the fact that there is a large excess of carbonic acid

in the atmosphere of the room, and this gas is highly deleterious to health.

The window can generally be utilised as a first-rate medium for the introduction of fresh air, but it must be done so that unpleasant draughts may, if possible, be avoided.

A simple and good plan is the fixing of a piece of wood, 3 inches deep by half an inch thick or so, at the top of the window, either

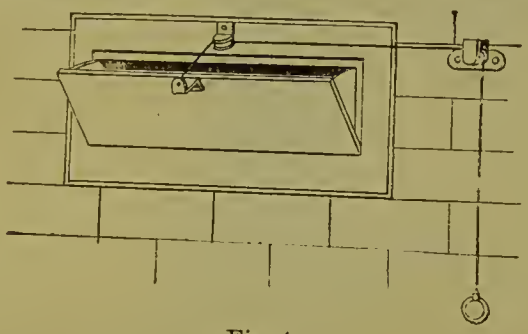


Fig. 4.

inside or outside, as shown at G in Fig. 2. This will allow the window to be pulled down so as to permit the air current to enter between the two sashes only, and in an upward direction. The amount of air passing in may thus be regulated as required. A pin is fixed

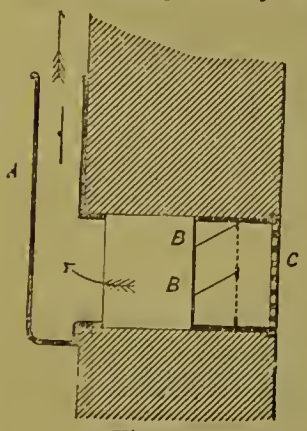


Fig. 5.

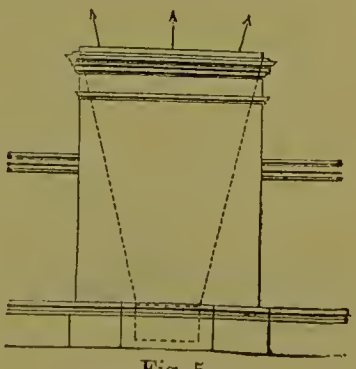


Fig. 5.

on the side of the upper sash, near the bottom, so that the window cannot be pulled down beyond G.

Another method is that shown in Fig. 3, where A is a movable glass frame. The Sheringham Inlet (Fig. 4) is useful as a wall inlet, takes up little space, and in many cases may be concealed by a picture if desired.

Tobin's Tubes or Brackets may be made in various styles, as shown at Figs. 5. They may be the same width vertically, or they may expand outwards towards the top, the intention of the taper being to assist the diffusion of the incoming air. Air filters are useful for excluding the dust, but they require attention, as they soon get choked up. Inlets, too, very often act as outlets, unless precautions are taken to avert this. The air may be blowing in through the tubes on the windward side of the building, and the reverse on the

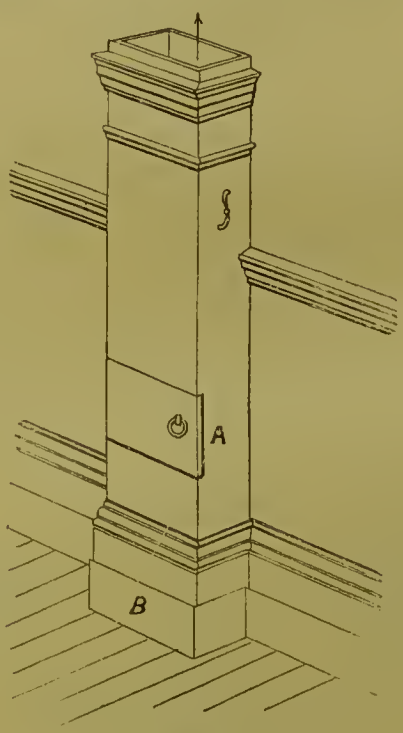


Fig. 5.

leeward side, as the air in those tubes moves towards the point of least resistance. In some cases self-acting valves, which close against the reverse current, are fixed as at B B in Fig. 5, page 13.

All inlet tubes should have means for regulating the amount of the incoming air when wished. Their sizes will vary according to circumstances, but should not be large and single, but rather numerous and small, so that the air may be properly distributed, and deliver six feet or so from the floor level.

The air coming into the entrance hall may be warmed by adopting a Grundy's or Shorlands' Patent Warm Air Ventilating Grate

or Stove, or a Warm Air Inlet Ventilator Radiator. The outlet ventilation is carried out, as shown in Fig. 6, by a fixed exhaust ventilator on the roof, with the necessary arrangements for regulating the outgoing current of air, and for the prevention of down draughts.

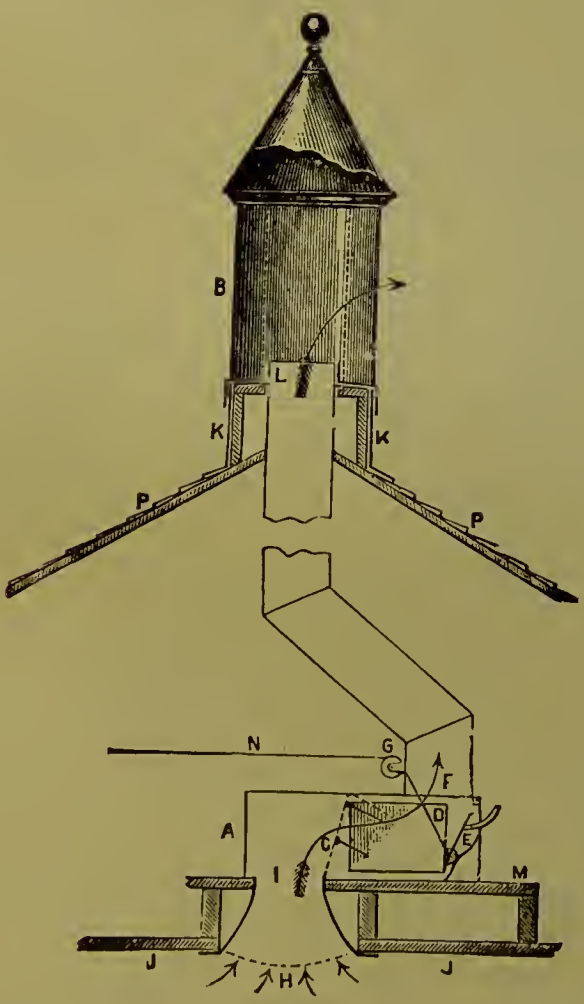


Fig. 6.

A burner may be fixed in the upright shaft at F, to assist the up current in calm weather, if considered necessary.

Having so far considered the inside arrangements for the thorough ventilation of the house, we next turn our attention to the roof, which we now suppose has been put on. Here the plumber comes

upon the scene in order to provide for making the house-tops weather proof, etc. The health of the inmates will now rest largely in his hands, and, therefore, the manner in which he proceeds to arrange for the conveyance of all water, whether rain or foul, from the house to its ultimate destination in the sewer must be briefly described.

THE HOUSE DRAINS.

Having taken the necessary levels to determine the gradient, the excavation of the trench for the laying of the drain pipes may be proceeded with. The bottom of the trench having been carefully prepared to the required gradient, if the soil be firm no further support is necessary. If loose soil is met with a firm foundation for the pipes must be provided, usually by laying a 6-inch bed of concrete.

Drains consist either of iron* or stoneware pipes. An iron drain is preferable when the drain enters the house.

A stoneware pipe drain, owing to its cheapness and durability, is largely used for outside drainage work, and generally fulfils all requirements. Stoneware pipes for house drainage should be well salt-glazed, perfectly smooth inside, of true circular section, uniform thickness of material, and straight in the direction of their length. They must also be tested as to their soundness before being laid.

It is necessary that the drains should have a good fall, and for self-cleansing purposes a gradient of 1 in 30 for a 4-inch drain, and 1 in 40 for a 6-inch drain will be required.

The connection of the house drainage system with the sewer having been made (generally by the town authorities) the plumber carries the drain pipes towards the house until he reaches a suitable position in the grounds for placing the main intercepting trap. The purpose of the trap is to lock off the sewer air or gas from the drainage system of the house.

* Messrs. Walter Macfarlane & Co., Saracen Foundry, Glasgow, make a specialty of iron drainage goods, etc.

The depth of the main trap will vary according to circumstances, and may be treated as indicated in the accompanying diagrams.

Fig. 7 A shows a section of the Buchan trap. In Fig. 7 B it is seen in position with shafts carried to the surface of the ground for cleansing and inspection purposes, and for the admission of air to the drainage system on the house side. The admission of air directly over the water in the trap is in many cases objectionable, and leaves it easy for children to put sticks or other materials into the trap

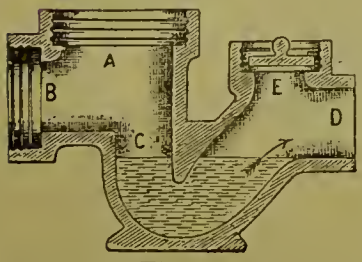


Fig. 7 A.

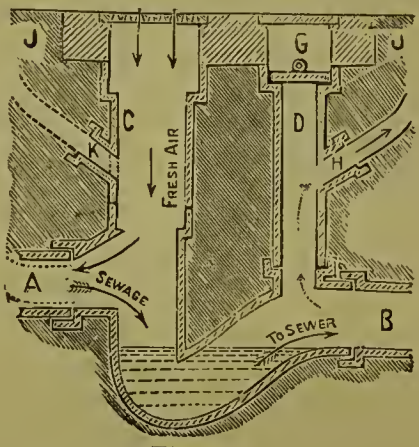


Fig. 7 B.

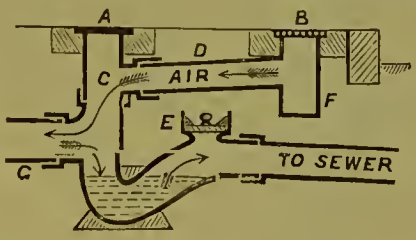


Fig. 7 C.

and so choke it up. A better plan is that shown in Fig. 7 C, where a close plate A is placed directly over the trap and a branch pipe carried from the vertical shaft to a suitable position. A dirt-box is built and a grating fixed as shown at B. In many cases the combination plate and grating frame is all that is necessary at the ground level over the trap. If the trap is deep in the ground a brick manhole, 3 feet by 2 feet or so, should be built for access to it.

Fig. 7 D shows the author's improved trap, spceially suitable for manhole purposes, etc. It allows every facility for cleansing, for access, or for inspection on both sides of the trap. A self-adjustable

air-tight stopper may be used at the sewer eye of the trap, instead of the usual stopper, which requires sealing down.

The main trap should be set in concrete as high as the standing water in the trap, as a preventive against possible leakage or breakage whereby the water seal is lost and communication with the sewer is established. The enamelled brick and open channel intercepting manhole, as now advocated by up-to-date engineers, is good, but is an expensive arrangement, and in many cases quite unnecessary.

It is presumed we have laid down a 6-inch diameter main drain,

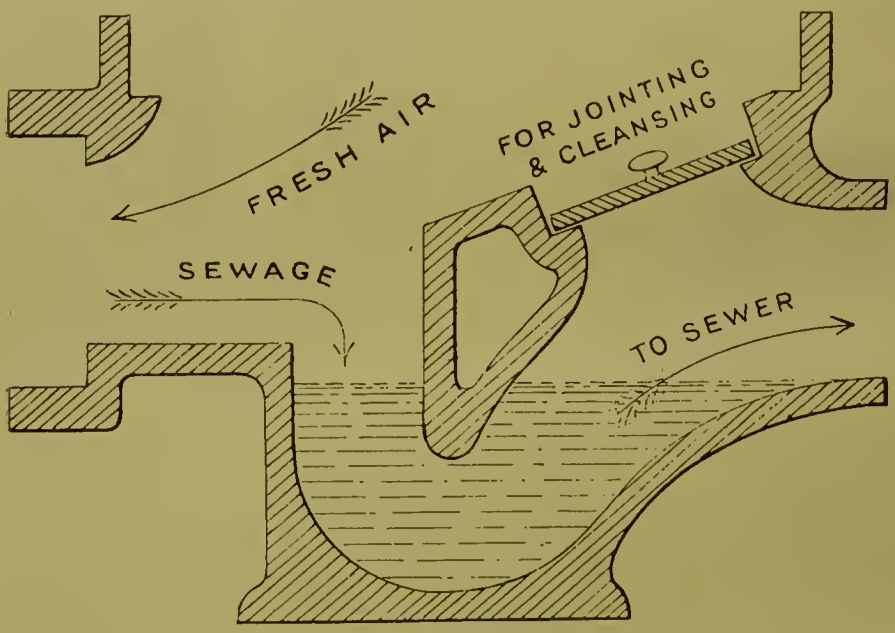


Fig. 7 D.

which is ample for draining any ordinary dwelling. The drain pipes should be led in a straight line from the main trap, their joints being properly caulked with gaskets of spun yarn, and well made with Portland cement. A good plan is to place an inspection pipe as at E in Fig. 8, whenever the daylight is obscured. By the periodical inspection of the interior of the drain as the laying of the pipes proceeds, the plumber can see at a glance that he has left no obstruction to the flow of the sewage. Various patent self-adjusting joints for drain pipes are now in the market. These pipes can be laid with special facility in wet ground as no cement is required for joining purposes.

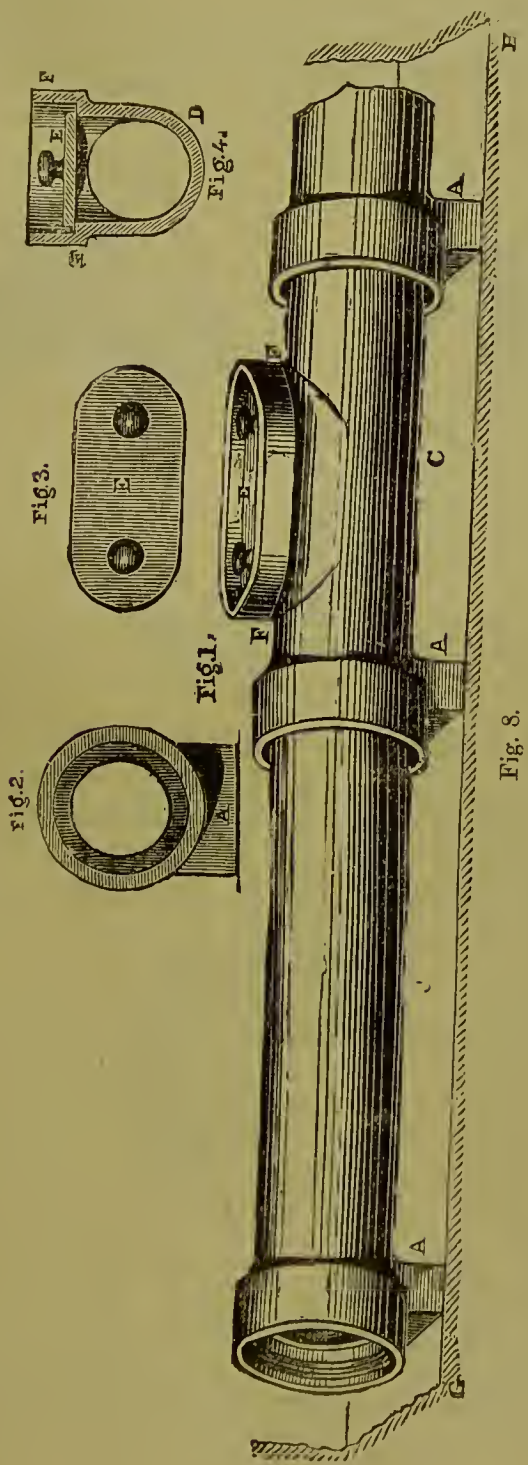


Fig.4.
Fig.3.
Fig.2.
Fig.1.
Fig. 8.

Access or inspection branch pipes or bends (Figs. 9 and 10) should be placed whenever the drain diverges from the straight, and every facility should be left for after-examination or in case of a stoppage occurring.

Fig. 9.

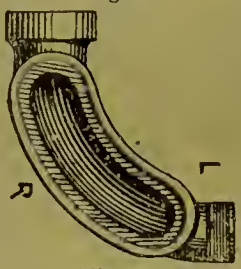


Fig. 10.

Branch drains entering the main drain should do so at acute angles, or by easy curves, and in no case should they enter at right angles, more especially when sewage matter is conveyed through them.

Having a stretch of the sewage pipes laid, it generally occurs that the ground has to be filled in as soon as possible afterwards. Such

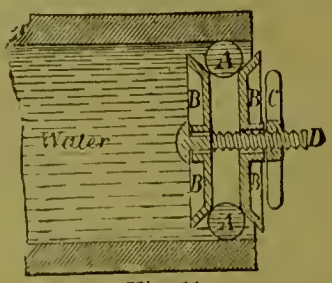


Fig. 11.

should never be done until the pipes and their joints have been tested as to their soundness.

Hydraulic pressure is by far the best test, and is easily carried out by inserting a water-tight plug* at the lowest end of the drainage

*Addison's Patent Plug is one of the best.

system, as in Fig. 11, and then filling the pipes with water either by hose or other means, and allowing the water to stand in them for some time. An examination of the pipes and joints is then made, and defects remedied if required before filling in the earth. In some cases the water can be allowed to stand in the pipes until the filling-in has been completed. The main drain may be tested in sections when long, and the branch drains treated similarly from the inspection openings as the work proceeds.

The filling-in of the ground should be proceeded with cautiously, care being taken to see that every pipe is well supported underneath, and the softest soil used for the covering of the pipes.

As we approach the house with the sewage pipes we must keep, if possible, a reasonable distance from the walls, leaving the necessary branches as we pass for the rainwater, wash-house, scullery, bath-room, and W.C. connections, and terminating with an inspection opening at the head of the drain.

The main drain has now been so far treated; but many prefer, for first-class work, that drains running near the outer walls of a house, when of stoneware, should be surrounded by concrete as a preventive against possible leakage.

RAIN PIPES.

Turning now to the consideration of the various pipes which pass from the house to the main drain, let us first treat of the rainwater pipes. Rain pipes should be intercepted from the main drain by a trap, so that the sewage air from the main drain may not gain access into them.

It does not follow that a separate trap is required for every rain stack, but where no waste or soil pipe intervenes, one intercepting trap may often serve for several rain pipes. In this case a rain water shoe is fixed at the bottom of each rain pipe, with access for cleansing purposes.

In many cases the rainwater is caught and stored and utilised for washing purposes, but if it is allowed to run to waste, by collecting

several rain staeks together and discharging them into the main drain at a high point, an effective flushing arrangement is seeured during rainfall.

In some cases where there is little fall a flush tank may be desirable.

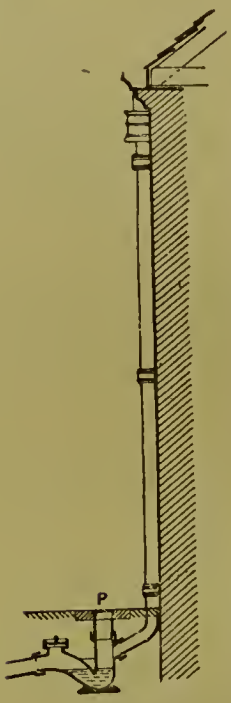


Fig. 12.

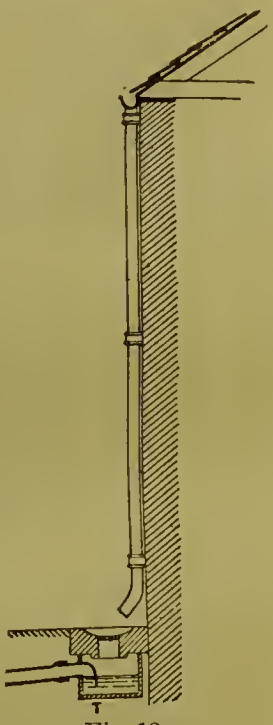


Fig. 13.

Fig. 12 shows a rain staek intercepted from the main drain.

Fig. 13 shows a different form of trap, commonly called a sand trap, which takes both the rain and surfaee ground water.

THE SCULLERY SINK.

The waste discharge from a kitehen or scullery sink always contains a large amount of greasy matter, whieh, if allowed to flow in its liquid state direct into the main drain, would soon beeome solidified and continue gathering until a eomplete stoppage of the drain takes place. The general plan is to intercept the grease in a

proper trap having a large body of cold water for the purpose of cooling the liquid grease into a solid. The grease may then be removed from the trap periodically by the lifter which stands in the centre chamber B, Fig. 14. It is advisable to use Condy's Fluid

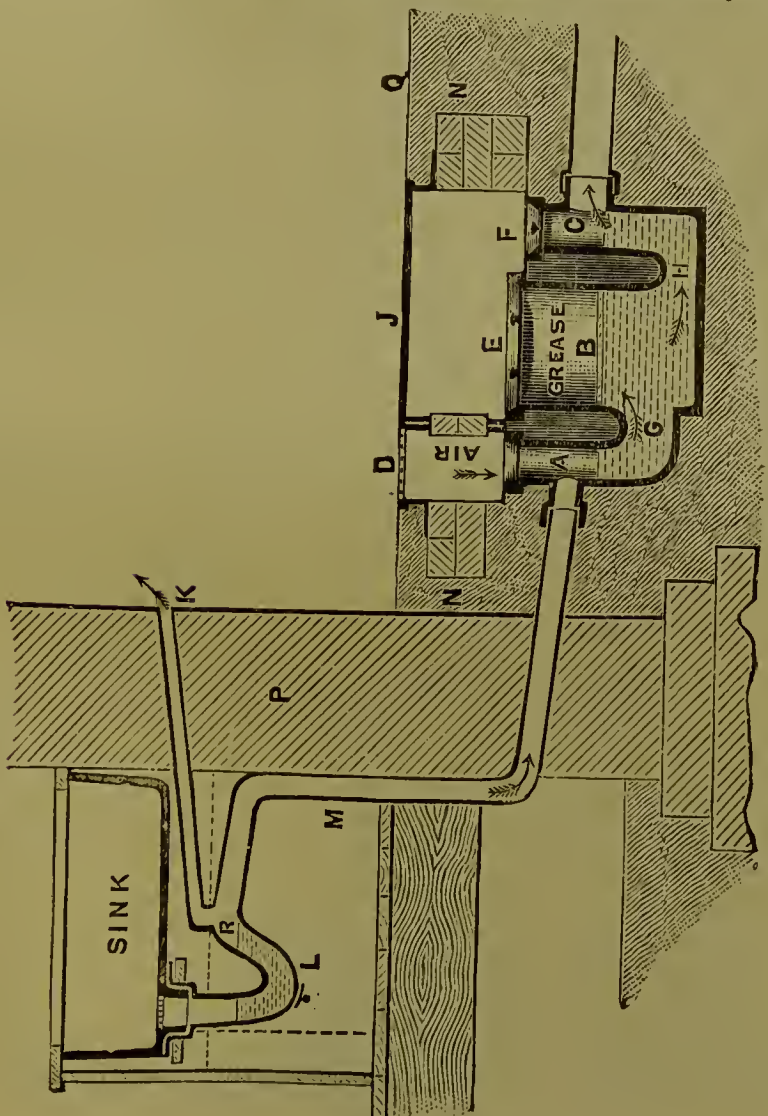


Fig. 14.

before disturbing the contents of the trap, as it not only deodorises but disinfects perfectly.

Some are in favour of using flushing grease traps. By the periodical flushing of the trap by an automatic siphon flush tank

the grease is broken up and forced through the drain in lumps. Water companies, however, will have something to say regarding the usage of such large quantities of water.

The grease trap having first been set upon a concrete bed, a good plan is to surround it with concrete as a preventive against breakage. The waste piping from the sink may be fitted somewhat as shown at Fig. 14. An iron pipe, of no less than a quarter of an inch thick, and coated for the prevention of oxidation, is carried through the wall, and above the floor level, the connection of the lead to the iron being made by a brass ferrule connection.

As all pipes from the house fittings get more or less foul and smelling, it becomes necessary to fix another trap, L, as near the fitting inside as possible, to prevent the foul air from getting access into the house. A circulation of air through the waste pipe is maintained as shown at D and K.

The sink may be of enamelled fireclay, and fitted up openly, either by brackets or enamelled supports, etc., so that the space underneath may be accessible for cleaning purposes.

THE WASH-HOUSE.

We now come to the wash-house. The reader will, by this time, be so far familiar with trapping that he will consider it advisable to intercept the wash-house drain from the main drain by an inter-

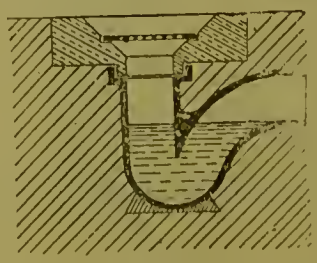


Fig. 15.

cepting trap, from which an iron drain will be carried inside to receive the surface floor water and the waste discharges from the tubs. A trap such as in Fig. 15 is a suitable one for surface water, the waste-pipe arrangement from the tubs being carried out as circum-

stances will permit. Fig. 16 gives a view of a wash-house having three enamelled fire-clay wash tubs,* resting on enamelled fire-clay

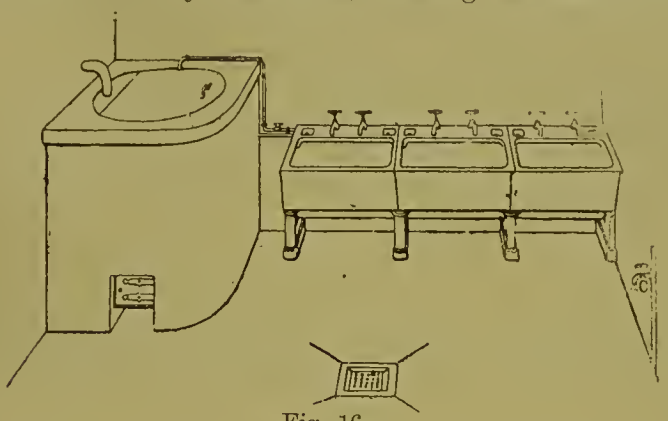


Fig. 16.

supports. These are now much used, and are preferable to wooden ones.

Fig. 17 gives a vertical cross sectional drawing showing the surface trap, drain, and waste-piping arrangement from the tubs. V is an

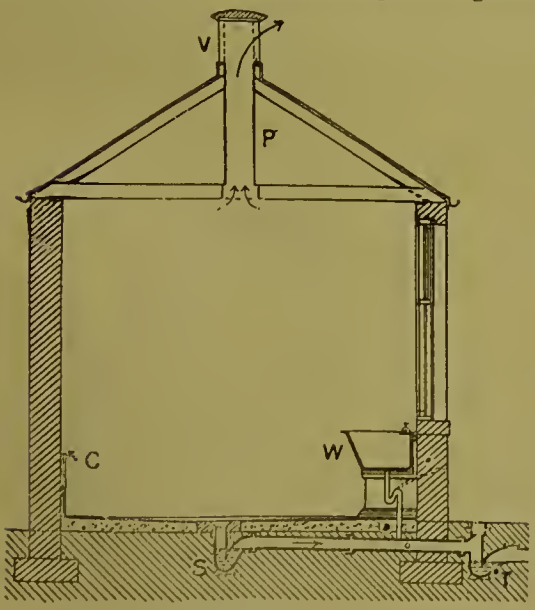


Fig. 17.

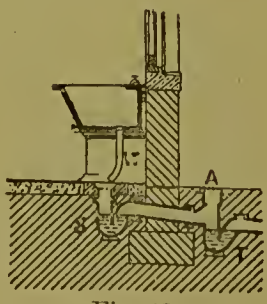


Fig. 18.

exhaust ventilator on the roof for the extraction of steam. Fig. 18 shows a simple way of arranging the piping and surface floor trap.

* Messrs. J. & M. Craig, Limited. Kilmarnock and Glasgow, make a specialty of enamelled tubs, sinks, and sanitary goods. They are also the sole manufacturers of Buchan's sanitary appliances.

A word may be said regarding the floor, which should be thoroughly water tight. Granolithic is now much used, and answers admirably, and if the walls be tiled the application of a water hose will speedily cleanse the place.

In districts where the water is of a hard nature the storage in tanks of the rainwater will prove a useful adjunct for washing purposes, a tap being fixed in the wash-house for drawing off the water, as shown in Fig. 19.

BATHS AND WASH-BASINS.

Modern plumbing now requires that a separate pipe be fixed for bath and basin waste discharges, this pipe being intercepted at its foot by a trap before entering the main drain. The waste pipe is open to the air at both ends.

The vertical piping is generally of iron, from 2 to 2½ inches in diameter, the branch wastes being either iron or lead, as found most

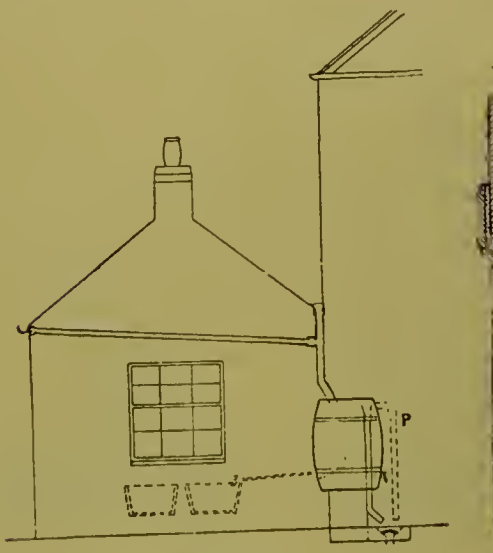


Fig. 19.

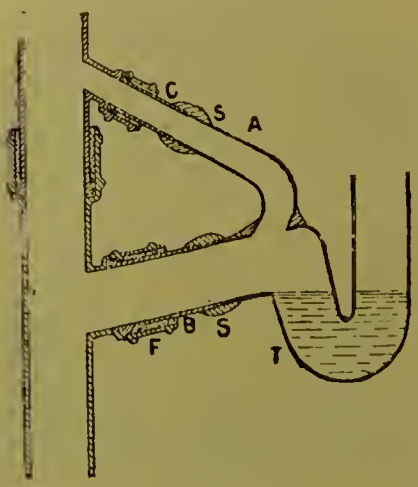


Fig. 20.

suitable, the joining of the lead and iron being done by brass ferrule connections, as in Fig. 20.

Lead piping is no doubt the best for standing the severe variations of temperature, caused by the quantities of hot and cold water passed

through the piping, and more especially when the waste pipe is inside the house, as fewer and more secure joints can be made than if iron were used. However, iron waste pipes, like iron drains, are now much in use, and if they are of a good thickness (no less than quarter of an inch), and properly fitted up, they fulfil all requirements, and may with safety be put in. The general system, however, is to place the waste pipe outside; no doubt a good position, but many proprietors know what cost it entailed upon them during the severe winter of 1895. In tenement properties especially great havoc was done to the waste piping outside, as whole stacks of vertical piping were frozen up through leaking water fittings, causing fractures of the pipes, etc.

Such rarely takes place when the piping is inside, and with regard to the value of outside pipes as compared with those inside, it is

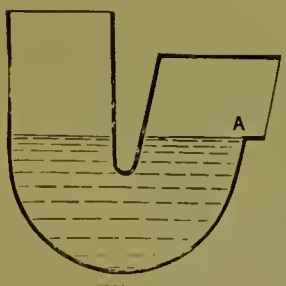


Fig. 21.

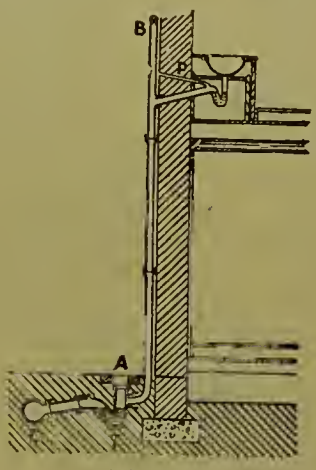


Fig. 22.

generally found that, as far as durability is concerned, those fixed inside wear much longer, and, as a rule, do not fracture so readily by expansion and contraction of the metal.

A body of water passing down a vertical pipe exerts both a driving and a pulling force, so it becomes necessary to guard against the unsealing of the various siphon traps connected to the fittings. If such takes place the traps in no sense of the word fulfil the purpose for which they were fitted. A badly made trap, again, is subject to momentum, and may loose its water seal independent of siphonage.

By using properly constructed traps as in Fig. 21 momentum may be stopped, and by the fixing of suitable air pipes on the branch wastes close to the traps, siphonage will be prevented as at A in Fig. 20

and at P in 22. The sizes of air pipes will be from $1\frac{1}{2}$ to 2 inches in diameter. Where fittings are overhead of one another and discharge into the same vertical pipe, the air or vent pipes are generally carried

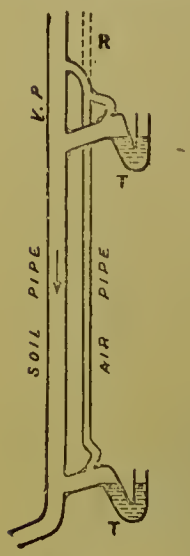


Fig. 23.

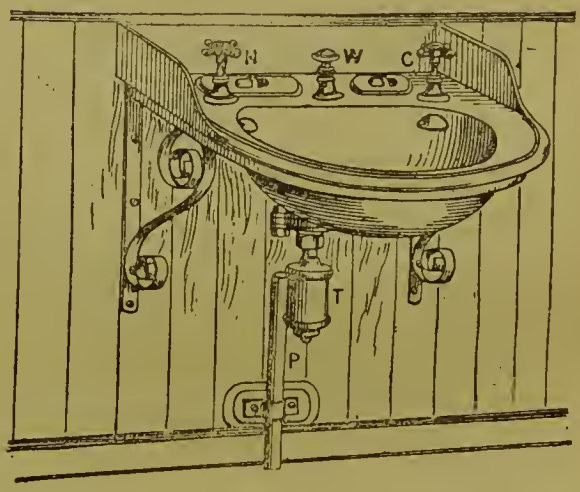


Fig. 24.

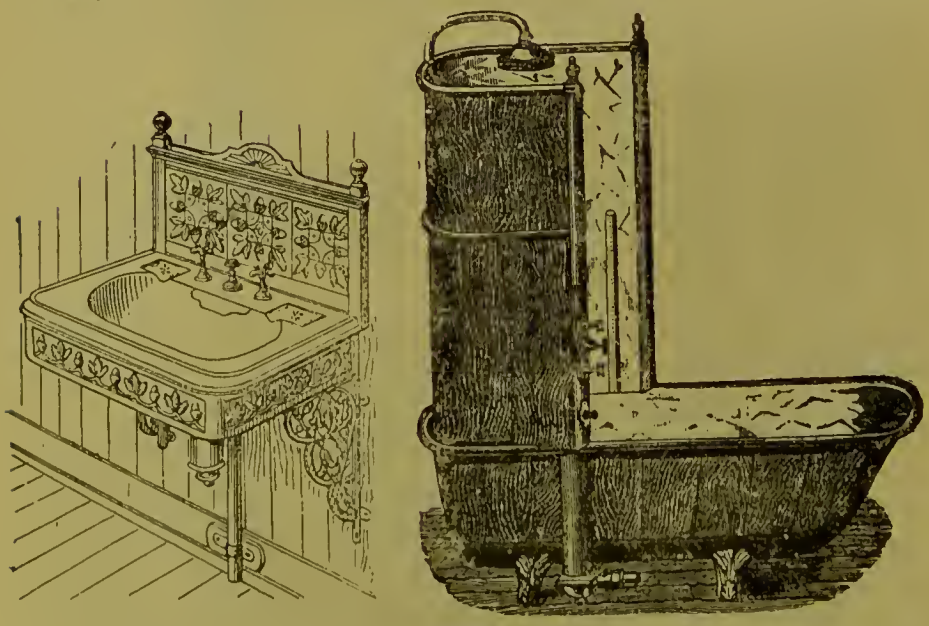


Fig. 24.

from the lower fitting up above the highest, and then connected to the main vertical waste pipe as shown in Fig. 23, or carried separately to the roof as at R.

The style of baths and basins now used in modern plumbing leave the fittings well exposed to view. It is preferable to the older forms,

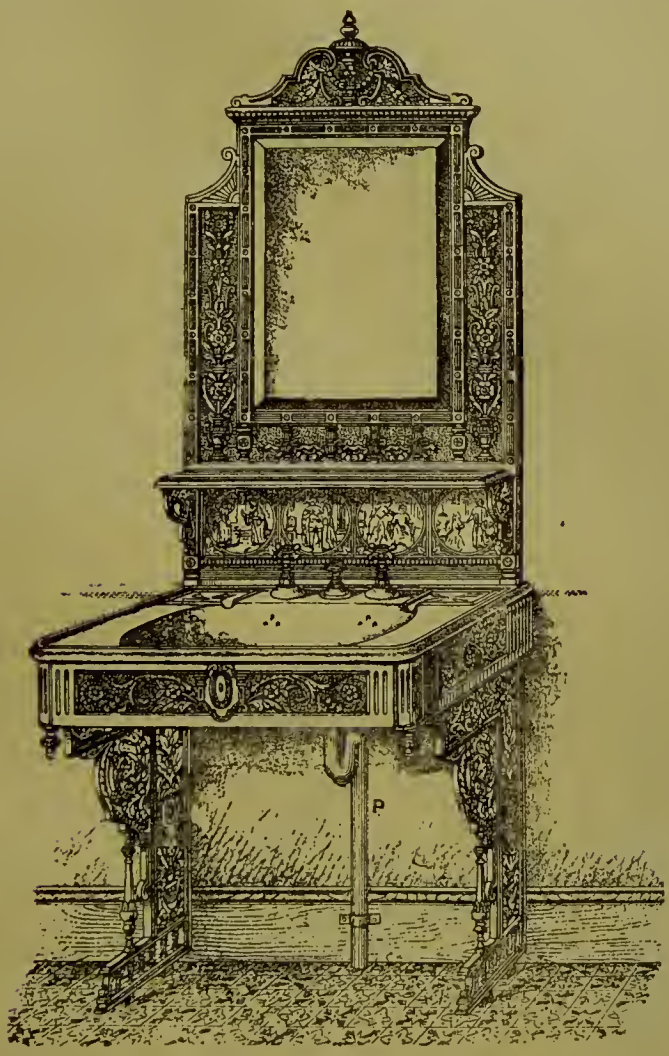


Fig. 24.

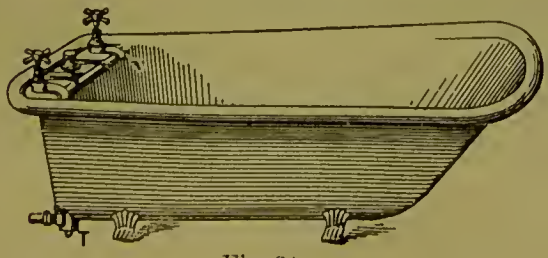


Fig. 24.

which are generally enclosed in wood-work and often found in a more or less dirty condition.

The styles are many and varied to suit all tastes and fancies, but all should possess outlets with clear water ways to allow for the speedy removal of their waste contents.

Messrs. Shanks, Doulton, Twyford, and Campbell & Sons, of Glasgow, have on show a varied assortment of sanitary fittings up-to-date similar to those shown at Figs. 24.

W.C. AND SOIL-PIPE.

The W.C. soil-pipe generally acts as the ventilator for the drain, and therefore differs so far from the other pipes in that no trap is put at its foot.

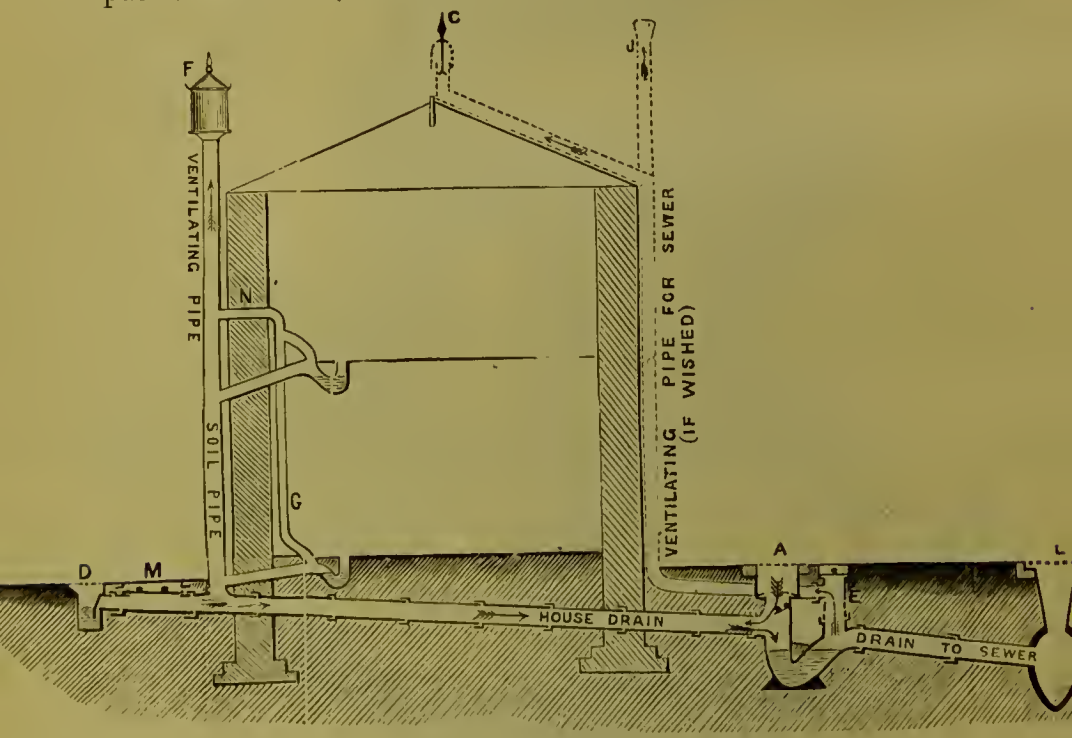


Fig. 25.

Where the main drain is short, this plan of drain ventilation by the W.C. soil-pipe fulfils all requirements; but if the main drain is

a long one, the intereepting of the soil-pipe may be advisable, and more especially in houses which are frequently vaeated.

Isolation, we are authoritatively told, is one of the best proteetives against infection. Why, therefore, not carry it out as far as possible in our houses as well as in our hospitals ?

As we are now dealing with the most deadly and infeetious pipe of the system, we kindly refer the reader to Fig. 25, which shows the W.C. soil-pipe acting as the ventilator for the main drain. Here the

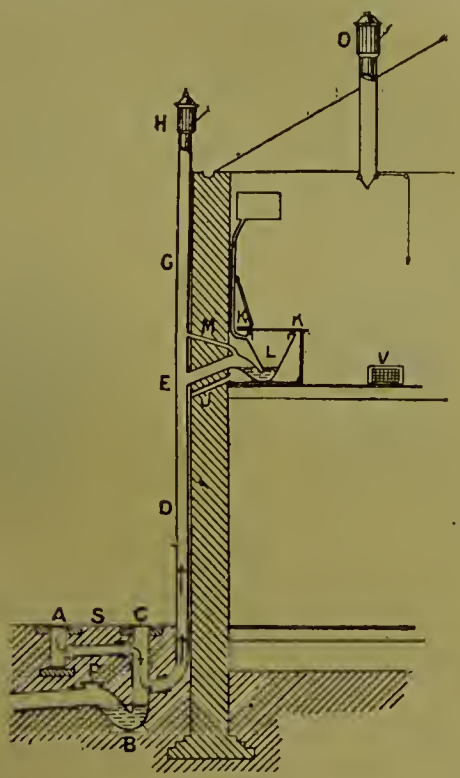


Fig. 26.

water seals of the siphon traps of the W.C. s inside the house are the only preventives of the ingress of sewage air from the whole drainage system.

Fig. 26 shows the invention of the late W. P. Buehan, patented in April, 1875, and still in use. He ealled it the tripartite eombined arrangement of exhaust ventilator upon soil-pipes, ete., with a trap and a fresh-air inlet at the foot. The side fresh-air inlet at A, Fig. 26, may in special cases, whcn near windows or doors, have cither a horizontal valve arrangement as in Fig. 27 to stop the

temporary exit of the air at the grating when the fitting is used, or a vertical pipe inlet where suitable, as in Fig. 28.

This system of disconnection is called the "Sectional System of House Drainage," and is possibly the safest to adopt at large houses, as it isolates every interior house pipe from the main drain. The main drain is independently ventilated by fixing a special pipe or pipes, commonly called the "blow off" for the drain.

This method was adopted at many mansions and houses by the late W. P. Buchan. Fig. 29 shows a ground plan of the drainage of Armadale Castle, in the Isle of Skye, as altered and improved by him in the spring of 1887. In this case the drainage system was carried out in two distinct parts, both sides of the house having its own separate system of drainage, as shown on the plan.

Whether the soil-pipe is intercepted or not, the fixing of it calls for careful attention, as a faulty connection or a badly-made joint

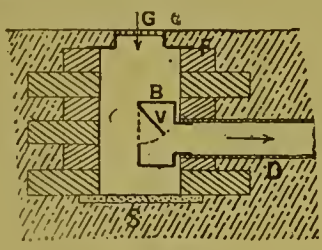


Fig. 27.

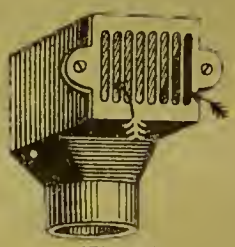


Fig. 28.

may be the means of causing illness, and this is more likely to happen where the soil-pipe acts as the drain ventilator.

The piping may be either lead* or iron, lead piping having much to commend it as a lasting material. When the joinings are made by plumber's wiped solder joints, and properly fixed and ventilated and of good material they may stand for centuries. Iron, however, is mostly used owing to the ease with which it is fixed, its greater cheapness, and its suitability in the majority of cases for outside purposes.

The vertical pipe is generally 4 inches in diameter, and should be from $\frac{1}{4}$ to $\frac{3}{8}$ of an inch in thickness, coated or glass-enamelled for the prevention of oxidation, etc., and carried full bore to the roof, clear of all windows, etc.

The foundation should be solid, preferably a heel-bend set in concrete, the joints of the pipes well staved with gaskets of spun

* Hydraulic drawn lead soil-pipe equal to sheet lead, 8 lbs. to the superficial foot.

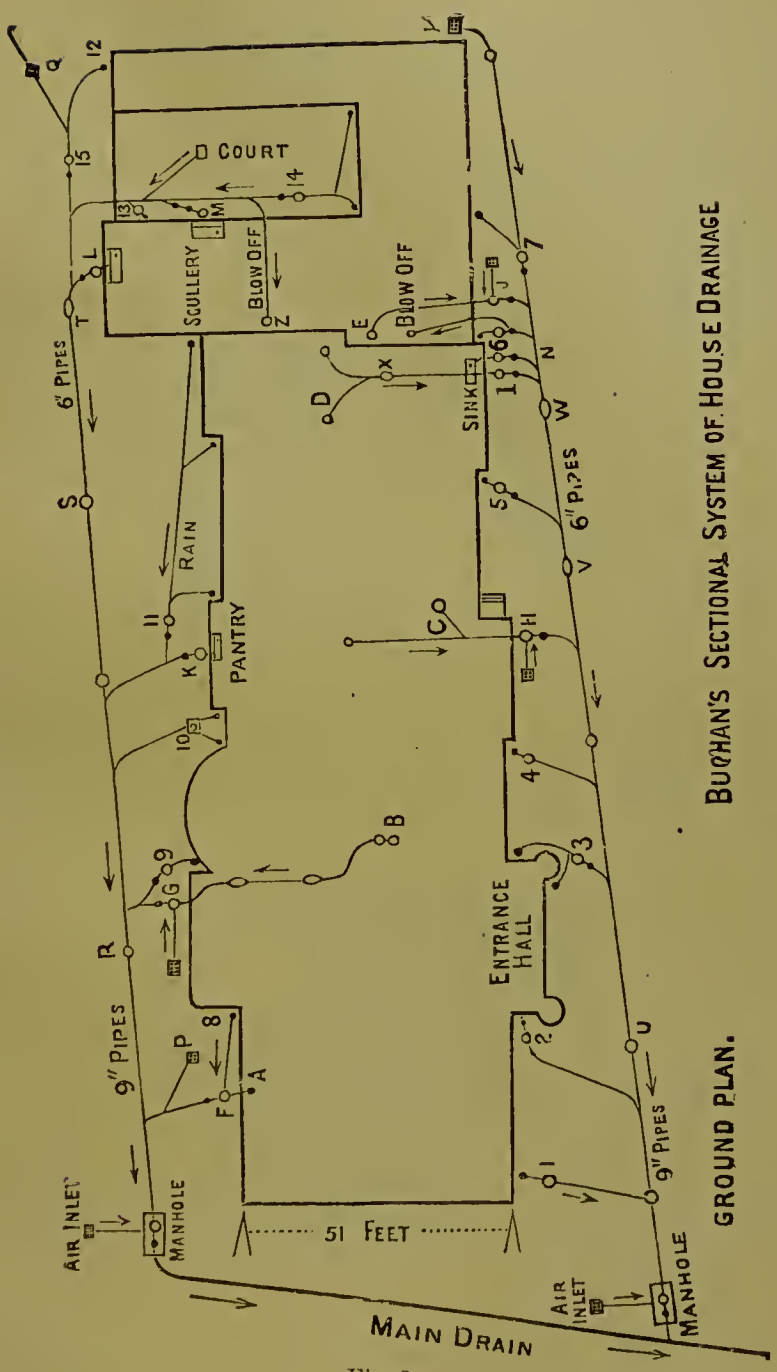

BUCHAN'S SECTIONAL SYSTEM OF HOUSE DRAINAGE
GROUND PLAN.
COURT
SCULLERY
BLOW OFF
BLOW OFF
SINK
6" PIPES
6" PIPES
RAIN
PANTRY
ENTRANCE HALL
9" PIPES
9" PIPES
AIR INLET
MANHOLE
51 FEET
AIR INLET
MANHOLE
MAIN DRAIN

Fig. 2

yarn, and then run with molten lead, which is afterwards staved home. The branch connections to the fittings may be lead or iron as found most suitable for the style of fitting adopted.

Soil-pipes, as a rule, do not require exhaust ventilators, but should have a copper wire netting on the top or other terminals, as birds are apt to build in them if left unprotected. The blow-off pipes, however, should be surmounted by exhaust ventilators to assist the air currents through the drain.

The fixing of the soil-pipe is similar to that of the bath and basin waste-pipe. Air-pipes, usually 2 inches in diameter, are likewise necessary off the branch wastes for the prevention of siphonage of the water traps. Siphonage of the water traps seldom took place where the old pan closet was the fitting in use. The water supply to the closet was so much broken up that a water plug was seldom formed in the piping to cause siphonage, even when the pipes were insufficiently ventilated.

Baths and basins again generally had their outlet gratings so small that the water never had a scouring effect on the sides of the pipes, no thought being given to such details. Therefore the introduction of new fittings has forced the plumber to fit in the necessary air-pipes for the prevention of siphonage of the water traps belonging to the fittings. Modern appliances possess means for the speedy removal of waste contents, tend to scour the piping and drains, and so keep the fittings, etc., as far as possible, wholesome.

Independent of their value as anti-siphonage pipes, all branch wastes should have air-pipes to allow a circulation of fresh air through all parts of the piping, and to act as a preventive against corrosion of the piping.

Testimony is given to the value of the plan of the late W. P. Buchan in the article on "Sewerage" in the new edition of the Encyclopædia Britannica. Professor J. A. Ewing, F.R.S., illustrates the Buchan traps, and acknowledges the "excellent service to the cause of sanitary reform rendered by the disconnection and ventilation of house drains and soil-pipes on the principle which Mr. Buchan has advocated."

THE W.C. FITTING.

Dr. Neil Carmichael, of Glasgow, in an important paper read by him to the Philosophical Society of Glasgow, in February, 1880, on "The Trap and Water Closet System," said: "A basin, with its outlet so curved as to form a siphon trap, the deepest part of which is seen from the basin, the whole formed of one piece of glazed

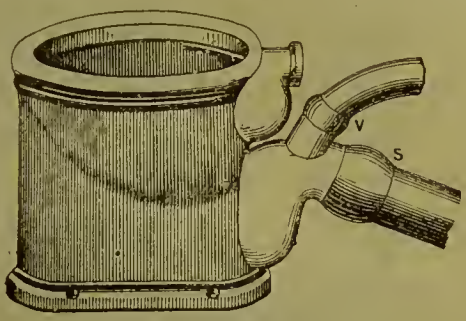


Fig. 30.

earthenware, fulfils all the conditions of a simple, clean, and safe closet."

These improvements were found embodied in Buchan's Patent "Carmichael" Wash-down Water Closet—a first-class closet when properly fitted up.

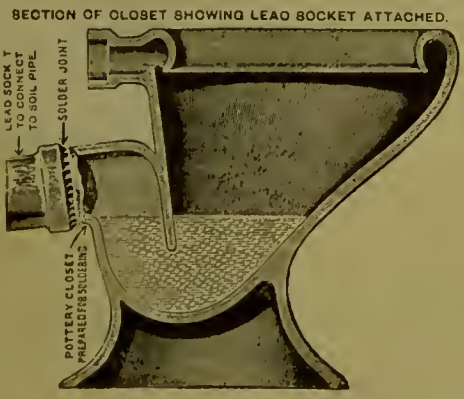


Fig. 31.

Since then various inventors have improved the style and shape of the wash-down, and it may now be considered a perfect closet, as the connection of the fitting with the soil-pipe, can be made by solder joints, as shown in Figs. 30 and 31, instead of by the usual red lead,

putty, or cement connection. A brass ferrule connection is used at the lead to iron socket of the branch to the vertical pipe.

Of the many styles of water closets in the market, numbers of them are dangerous in the extreme, owing to their traps having little or no water seal or lock, and giving no safeguard against evaporation.

The up-to-date closets are on the siphonic principle, and are called

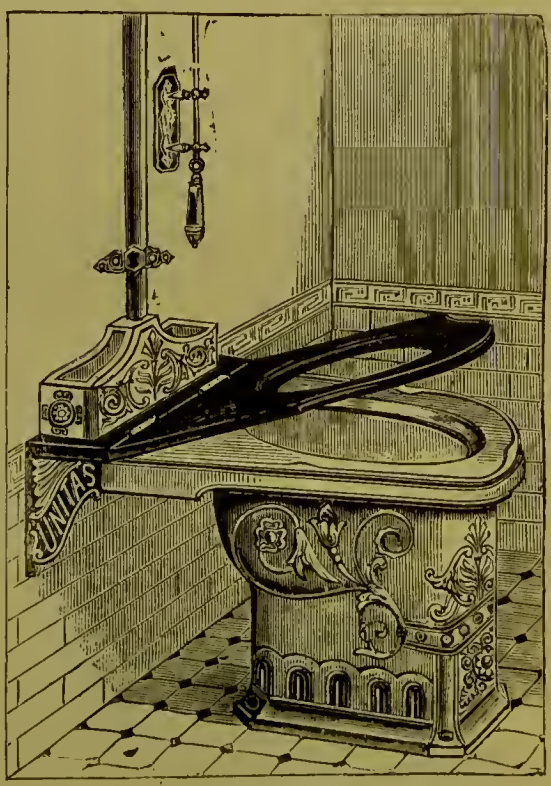


Fig. 32.

Shanks' Patent "Barrhead" Siphonic Closet and "Twycliffe" Patent Pedestal Siphon W.C. Basin. Messrs. Doulton have also a new form of closet.

A closet, no matter of what style, is of little use unless the necessary flushing arrangement is good.

The cistern is generally on the siphon principle. Some, however, are poor and noisy appliances, therefore choose a good one, as a good article always turns out cheap in the long run, because repairs are seldom required.

Shanks' "Levern" and Conolly's "Tolmer" are good flushing siphon cisterns, but there are numerous others to choose from, and all should be, when of iron, either galvanized or glass-enamelled.

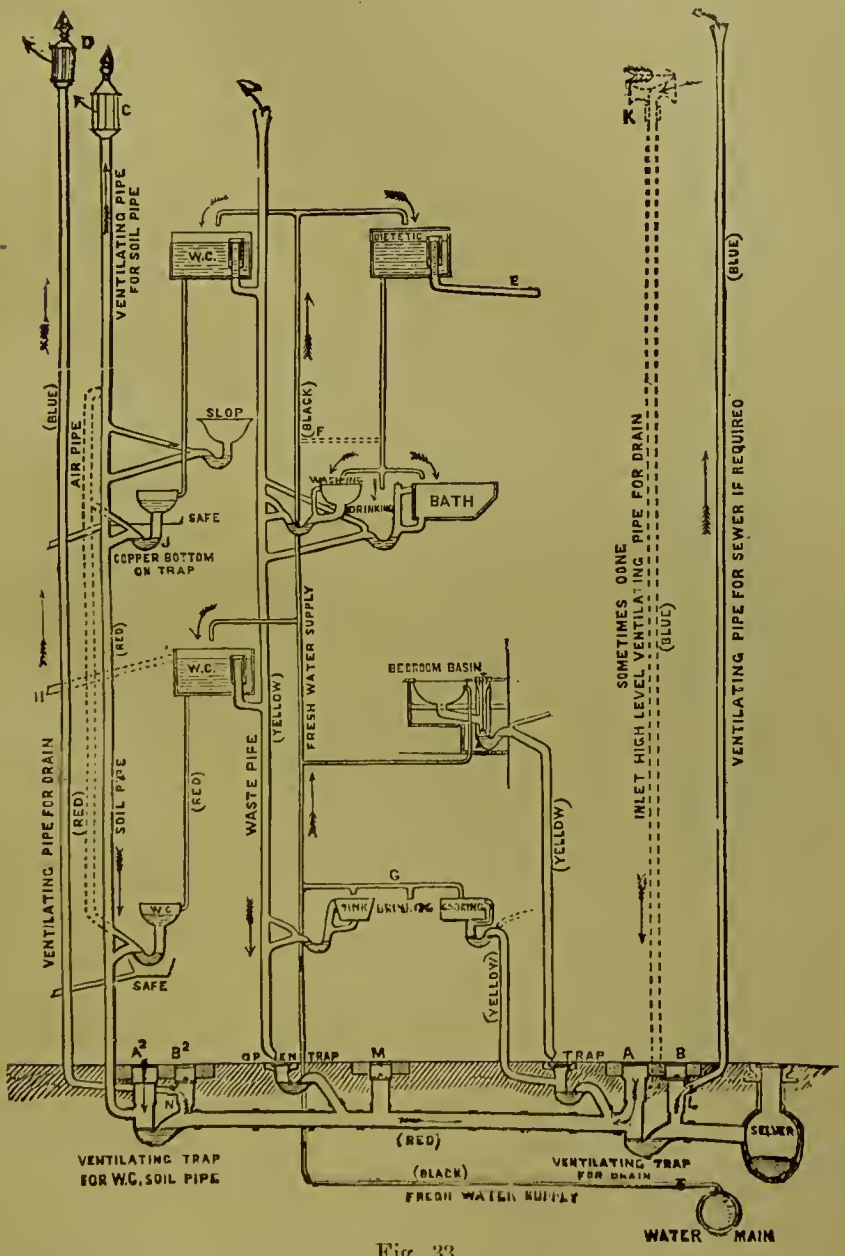


Fig. 33.

The wash-down W.C., Fig 31, has now superseded the wash-out W.C., Fig. 32, as a more sanitary fitting, having much to commend

it. The seat is generally hinged, as shown in Fig. 32, which allows for the emptying of slops, etc., without wetting the seat.

Fig. 33 shows in vertical section the general arrangements for providing, in a safe and satisfactory manner, for the water supply and drainage of a house. The W.C.s, bath, and basins as shown in the figure, are those in use in many of the older class of houses, and, therefore, are not up-to-date, but are fairly satisfactory. Waste-pipes should discharge into intercepting traps, and not over the gratings as shown in the figure.

A word may be said regarding the W.C. apartment itself. If possible, it should be against an external wall, or, better still, apart from the main building, and with ample window light. Means for the removal of the vitiated air should not be overlooked, as the fixing of an air inlet at the floor level, and an outlet at the ceiling, as in Fig. 26, will tend to keep the atmosphere of the apartment free from personal smells.

TESTING OF HOUSE DRAINS, ETC.

The smoke test, as invented by the late W. P. Buchan, is now universally adopted as a means of testing drains and house piping, both by private parties and also by the sanitary authorities of cities and towns.

The test is generally applied from the various traps, the smoke being forced through the drains and piping, as in Fig. 34, all outlet pipes being, however, temporarily closed during the test. Any leakage is soon made apparent to the eye, or by the odour of the burning material, and defects are thus traced.

Any novice may apply the test, but care and attention are required to see that the smoke has travelled into all the pipes, branches and air-pipes, and appeared issuing from them, before they are temporarily stopped up. The forcing of water traps has also to be guarded against, as some testing machines are liable to do so under certain conditions. No closet, basin, or bath must be used when pipes are undergoing the test, as the water seals of the traps belonging to the fittings may be affected through siphonage, thereby allowing the smoke access into the house.

The remarks published in "The Sanitary Record" of 15th April, 1893, are worth repeating here: "The reliable and successful drain tester should possess a certain amount of inventive ability, and be of ready resource; above all, he must have great patience, and must find out everything for himself as indicated by the tests, and not take anything for granted, and information given to him by those who profess to know should be gratefully received, but, at the same time, he should satisfy himself of its accuracy and value."

Many householders have annual tests of their house piping made, but some, however, have a curious way of doing it. Instead of

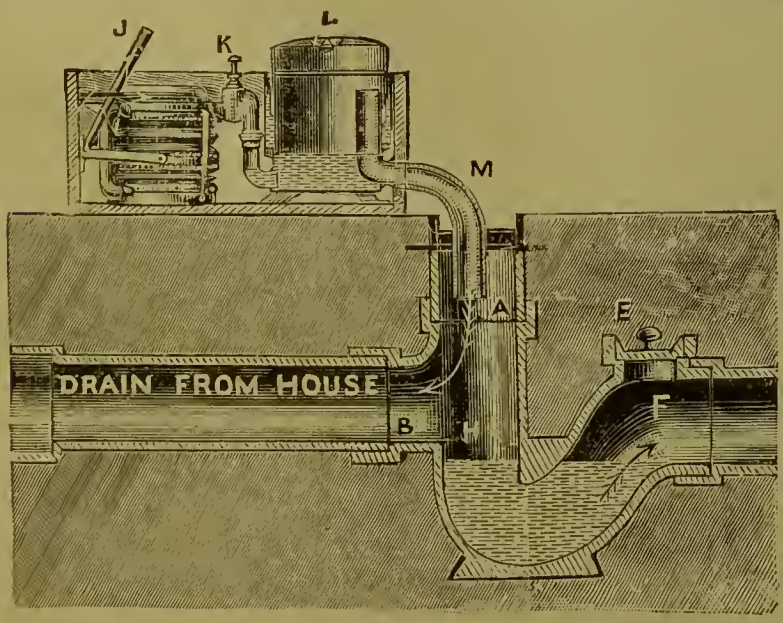


Fig. 34.

having the testing done when the house is vacated, as in the summer months, so as to give time to rectify things if necessary, they wait until a day or two before coming home, just as if the mere testing itself were the cure.

All houses which have been shut up during the summer months should have the plumber in attendance before occupancy again, so that all traps may be cleaned out, re-charged, and well flushed, and a general survey of the fittings made; for danger may accrue from the various traps having lost their water seals through evaporation or some other cause, thus leaving a free entrance into the house for that now dreaded fiend, Sewer and Sewage Air.